| Summary | |
|---|---|
| In this activity, students use numeric, algebraic, and graphical representations to find the maximum volume of an open top box. Students construct an open top box and answer various questions related to cubic functions, including the difference between the domain/range of a function and the domain/range of a problem situation. Other characteristics are included such as max/min, end behavior, roots, and finding values. This activity is an elaborated version of many 'maximum box' problems you find in various textbooks. | |
| **Utah State Core Standard** | |
| | |
| **Desired Results** | |
| **Benchmark/Enduring Understanding** | |
| Students will use multiple representations to find and show the representation of the volume of an open top box. | |
| **Essential Questions** | **Skills** |
| ▪ How are functions used to solve real world problems in the business world?<br>▪ What goes into determining the shapes and sizes of merchandise? | • Students' will be able to problem solve and explain reasoning<br>• Students' will deepen their understanding of characteristics of functions (including 'maximum value') |
| **Assessment Evidence** | |
| • Observations of students discussions<br>• Volume of a box quiz<br>• | |

| Instructional Activities |
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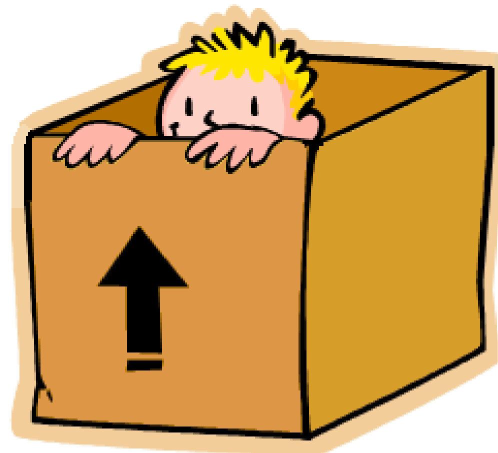
| Launch: The introduction to the problem is the launch, although if time permits, a warm up focusing on graphing polynomials can also be helpful (focus: end behavior, multiplicity, max/min, domain/range)<br>Explore: Students continue through activity and discuss possibilities<br>Summarize: Class conversation about how students came up with solutions. Options for summarizing include a discussion on how this problem relates to polynomials in general and how this activity compares to the falling bodies activity (Algebra II). |
| **Materials Needed** |
| Worksheet, calculators, scissors, tape |

# Box it Up!!

**You work for an open top cardboard box company. All of your materials (cardboard) come in 18 units x 24 units pieces. Your job is to find various shapes of open top boxes and determine the largest volume possible.**



1. Take a sheet of cm graph paper and cut out a rectangle with the following dimensions: 18 units x 24 units. This is your piece of cardboard.
2. Cut an x by x square from each corner of your "cardboard" so you can fold up the sides to create an open-top box. You choose how big you want the square to be, but remember you are trying to find the maximum volume.
3. Find the volume of your box. Show all work here:
4. Create a table that would give you the volume of 3 different boxes (created by cutting out different size squares from each corner of your 'cardboard' so you can fold up the sides to create an open top box).

| Height | Length | Width | Volume |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

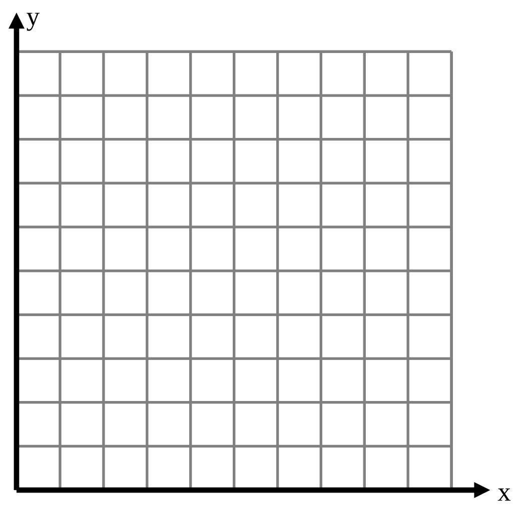
**Explain** (in words) how you determined the values if length, width, and height for this rows of information in your table.

5. Using your highly intellectual skills that have landed you this job, write an **equation** to determine the volume of a box that has a height of x centimeters.

6. What is the smallest height possible for this box? **Explain**

7. What is the largest height possible for this box? **Explain**

8. What type of function have you created to represent this equation? Sketch a graph you think represents this problem. Graph the equation below. Again, make sure to label your input/output values.




9. Discuss the difference between the domain of the function and the domain of the problem situation.
    a. Domain of function: b. Domain of situation:

10. Same for range.
    a. Range of function: b. Range of situation:

11. What is the smallest volume possible?
12. What is the largest volume possible?
13. If you cut out a 3.2 cm square, what will be the volume?

14. If your client wants the volume to be 250 cubic centimeters, what should be the height of the box?